

What is claimed is:

1. A catheter for changing the shape of an embolus comprising:
a first elongate shaft having a proximal end, a distal end and a lumen
5 therethrough;
a second elongate shaft at least partially disposed in the lumen of the first elongate
shaft, the second shaft having a proximal end, a distal end and a lumen therethrough;
a tip disposed on the distal end of the second shaft having a cavity fluidly
connected to the lumen of the second shaft and a distal opening, the tip movable between
10 a first state and a second state wherein the distal opening has a greater cross-sectional
area in the second state than in the first state; and
a vibratable wire for changing the shape of an embolus at least partially disposed
within the lumen of the second elongate shaft.
- 15 2. The catheter of claim 1, wherein the wire is configured to unclog the
lumen of the second elongate shaft.
3. The catheter of claim 1, wherein the wire is configured to fragment the
embolus.
- 20 4. The catheter of claim 1 wherein the cavity has a greater volume in the
second state than in the first state.

5. The catheter of claim 1 wherein the distal opening is proximal the distal end of the first elongate shaft in the first state and wherein the distal opening is distal the distal end of the first elongate shaft in the second state.

5 6. The catheter of claim 1 wherein the second elongate shaft comprises a shape memory polyurethane.

7. The catheter of claim 1 wherein the second elongate shaft comprises a nitinol coiled sheet catheter.

10

8. The catheter of claim 1 wherein the second elongate member comprises an expandable braid.

9. The catheter of claim 1, further comprising a vacuum source fluidly
15 connected to the distal end of the first shaft.

10. The catheter of claim 1, further comprising a vacuum source fluidly connected to the distal end of the second shaft.

20 11. The catheter of claim 1, further comprising a clot pulling device disposed within the lumen of the second elongate shaft.

12. The catheter of claim 11, further comprising a third elongate shaft having a lumen at least partially disposable in the lumen of the second elongate shaft, the clot pulling device at least partially disposable in the lumen of the catheter.

5 13. The catheter of claim 1 wherein in the second state the distal opening has a cross-sectional area that is larger than the cross-sectional area of the lumen of the first elongate shaft at the distal end.

14. A catheter comprising:
10 a first elongate shaft having a proximal end, a distal end and a first lumen therethrough;
a wire having a proximal end and a distal end at least partially disposed in the first elongate shaft, the distal end extending distally from the first elongate shaft; and
a motion control apparatus connected to the proximal end of the wire.

15 15. The catheter of claim 14 wherein the motion control apparatus can impart a vibrating motion to the wire.

16. The catheter of claim 15, wherein the vibrating motion has a frequency
20 less than about 20 kHz.

17. The catheter of claim 16, wherein the vibrating motion has a frequency of between about 1 Hz and about 150 Hz.

18. The catheter of claim 15, wherein the vibrating motion is axial.
19. The catheter of claim 14, further comprising a device attached to the distal end of the wire for changing the shape of an embolus.
- 5 20. The catheter of claim 19, wherein the device is configured to change the shape of the embolus to unclog a distal catheter lumen.
21. The catheter of claim 19, wherein the device is configured to fragment an
10 embolus.
22. The catheter of claim 19 wherein the device is an arcuate wire.
23. The catheter of claim 19 wherein the device is a wire having a zigzag
15 shape.
24. The catheter of claim 19 wherein the device is a loop.
25. The catheter of claim 19 wherein the device has a working range of about
20 20 mm proximally and about 100 mm distally.
26. The catheter of claim 25 wherein the device has a working range of about
2 mm proximally and about 15 mm distally.

27. The catheter of claim 20, further comprising a vacuum source fluidly connected to the distal end of the first elongate shaft.

28. The catheter of claim 27, further comprising a second elongate lumen disposed in the first elongate shaft, the wire at least partially disposed in the second lumen.

29. The catheter of claim 14 wherein the distal end of the first elongate shaft proximate the first lumen is angled.

30. A method comprising the steps of:
providing a catheter having a wire for fragmenting an embolus at least partially disposed within a lumen of the catheter;
positioning a distal end of the catheter proximate an embolus; and
manipulating the wire to change the shape of the embolus.

31. The method of claim 30 wherein the step of manipulating the wire includes the step of unclogging a lumen to assist aspiration of the embolus.

32. The method of claim 30 wherein the step of manipulating the wire includes the step of fragmenting an embolus.

33. The method of claim 30 wherein the step of manipulating the wire includes the step of direct operator manipulation of a proximal end of the wire.

34. The method of claim 33, further comprising the step of providing a handle attached to a proximal portion of the wire for direct operator manipulation.

5 35. The method of claim 30, further comprising the step of providing a motion control apparatus attached to the wire, and wherein the step of manipulating the wire includes the step of operating the motion control apparatus.

36. The method of claim 35, wherein the step of operating the motion control
10 apparatus imparts a vibrating motion to a distal portion of the wire.

37. The method of claim 36, wherein the vibrating motion imparted has a frequency of less than about 20 kHz.

15 38. The method of claim 37, wherein the vibrating motion imparted has a frequency within the range of about 1 Hz to about 120 Hz.

39. The method of claim 30, wherein the embolus is located in a patient's vasculature.

20

40. The method of claim 30 wherein the step of positioning the distal end of the catheter includes the step of positioning the distal end of the wire within the embolus.

41. The method of claim 30 further comprising the steps of
providing a vacuum source fluidly connected to the distal end of the catheter, and
operating the vacuum source.

5 42. The method of claim 41 further comprising the step of flushing a region
proximate the embolus with a fluid.

43. The method of claim 41 wherein the step of operating the motion control
apparatus includes the step of operating the motion control apparatus intermittently.

10

44. The method of claim 40 wherein the steps of operating the motion control
apparatus and flushing are performed simultaneously.

45. The method of claim 43 wherein the steps of operating the motion control
15 apparatus and flushing are performed exclusive of each other.

46. A method comprising the steps of:
positioning a guide catheter proximate an embolus;
positioning a second catheter having an expandable tip section within the guide
20 catheter;
expanding the expandable tip section distal the guide catheter; and
urging the embolus into the expandable tip section.

47. The method of claim 46, further comprising the step of providing a vacuum source fluidly connected to the second catheter and wherein the step of urging comprises the step of operating the vacuum source.

5 48. The method of claim 46, further comprising the step of positioning a clot puller device within the second catheter and wherein the step of urging comprises the step of engaging the embolus with the clot puller device.